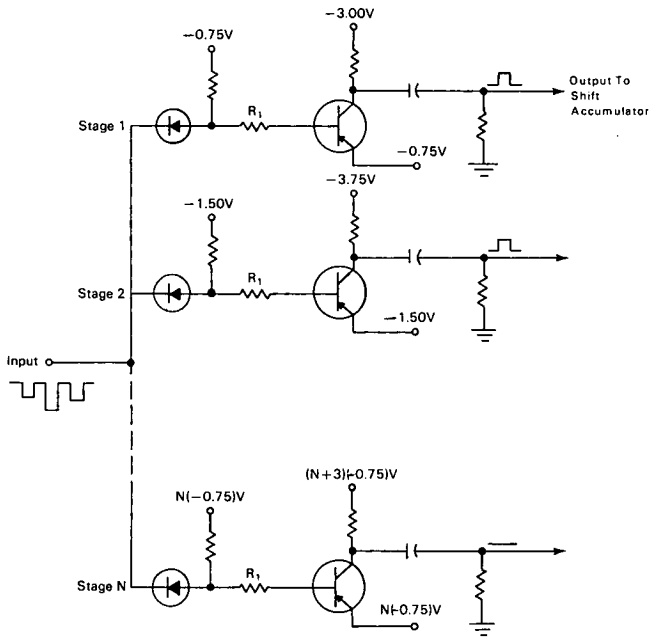
NASA TECH BRIEF

Pulse Height Analyzer Operates at High Repetition Rates, Low Power



The problem: Providing a pulse height analyzer that operates at pulse repetition rates as high as 10 to 20 megacycles per second. Conventional pulse height analyzers employing digital feedback circuitry cannot be driven at such high pulse rates and waste power when no input pulses are applied.

The solution: A simple multistage transistor gating circuit that compares the input pulse heights (voltages) to discrete reference voltages. The number of stages required for this circuit is determined by the range of pulse heights to be measured, and only seven components are needed for each stage.

How it's done: Each pulse in a train of negative pulses is admitted simultaneously to the base of the transistor in each of the stages (1 to N). The transistors (base and emitter of each transistor) are biased by a reference voltage so that they produce an output voltage for any pulse height less (i.e., greater in absolute value) than the particular reference level. The reference levels are established in decreasing equal increments. As shown in the circuit diagram, the reference bias voltage for the first stage is −0.75 volt; for the second stage, −1.50 volts; and for the Nth stage, N(−0.75) volts. The voltage references may be chosen so that the circuit measures any desired voltage difference, the minimum difference being determined by the transistor used.

When no input pulse is applied, all the transistors are turned off, because each transistor is biased to the

(continued overleaf)

same extent (voltage on base equals voltage on emitter) by the regulated power supplies V1, V2, ... VN. The diodes block interaction between stages, and thus prevent one stage from turning on another stage. When a negative pulse on the input terminal is less than −0.75 volt, for example, the first-stage transistor begins to conduct and an output voltage pulse appears at its collector. This pulse is then stored in the shift accumulator. As the input voltage continues to decrease to lower bias levels, succeeding stages (i.e., stage 2, 3, etc.) turn on, and their outputs are stored in the shift accumulator. The height of each pulse is read from the accumulator position that corresponds to the highest stage for that pulse.

Notes:

1. The collector voltage supplies need not be closely regulated.
2. For operation at low frequencies (less than 300 kc per sec) a single voltage supply with a resistive divider may be satisfactory for the base and emitter bias voltages. At higher frequencies, however, a separate regulated supply will be needed for each of these voltages.
3. The operating speed of the analyzer can be increased by shunting each resistor R_1 with a capacitor.
4. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Western Operations Office
   150 Pico Boulevard
   Santa Monica, California, 90406
   Reference: B65-10041

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: Space Technology Laboratories, Inc.
under contract to Western Operations Office
(WOO-046)